THE MODEL ENGINEER

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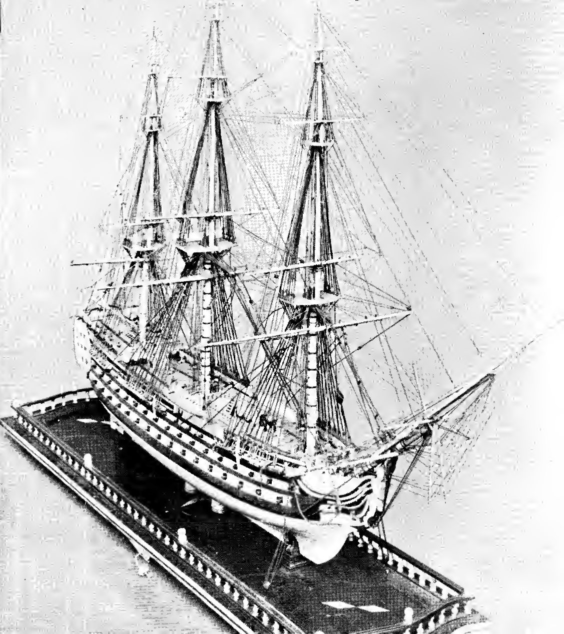


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

16TH JUNE 1949 VOL. 100 NO. 2508

SMOKE RINGS

Our Cover Picture

● THE MODEL shown on our cover picture this week is an exceptionally fine example of the larger type of these models. The scale is 1 : 96 or $\frac{1}{8}$ in. to 1 ft. The model is named *Ocean*, but differs in some details from the French ship of this name which was launched at Brest in 1790, and carried 120 guns. A model of this ship is preserved in the Musée de la Marine in Paris. Makers of these bone models were often somewhat casual in the names they gave them. The elaborate carving and rigging is characteristic of the better class of these models, as is also the oversized figurehead and the inaccurate head rails. In the prototype, the gun ports probably did not follow the line of the wales, but in the model the effect of the black wales against the white sides is very fine. Moreover, these bone models must be considered as works of art rather than as replicas of the ships after which they are named, and as such they are very beautiful and very satisfying. The photograph is Crown Copyright, and is from an exhibit in the Science Museum, South Kensington.

Bricks With or Without Straw?

● IN THE course of an interesting letter from a Wolverhampton reader, he comments : "The great snag that prevents my taking part in the activities described in *our* weekly is that I have no lathe, no bench driller or shaper, etc., but I have a thousand tools which I have bought during my career as an engineering fitter. I have discovered, also, that there are numbers of enthusiasts in this area in the same position."

He goes on to suggest that, to help him and others like him, we should publish designs for models that, with a little ingenuity and skill, can be made up with the aid of the file, scraper, breast-drill and the average hand-tool kit.

This is not, by any means, a new suggestion, and we are sorry to be obliged to point out that it is based on a fallacious idea. Thousands of models have been made by using just the equipment our correspondent mentions ; some of them were good, others not so good, as models. The crux of the whole matter is that the success, or otherwise, of this kind of work depends *entirely* upon the skill and ingenuity of the maker. These are qualities that are inborn and cannot be *taught* ; neither we nor anybody else can teach a man to be ingenious. By practice, skill can be acquired in any craft, provided that the individual concerned has the necessary aptitude for perseverance. But the ability to adapt tools to other than their usual uses depends, to some extent upon knowledge born of experience, but to a much greater extent upon intellectual capacity.

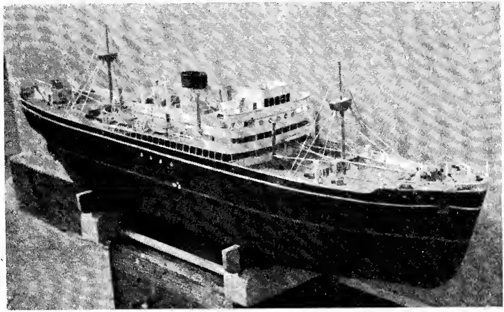
We are constantly publishing descriptions

of models the building of which has involved overcoming the difficulty caused by the lack of some implement that would more normally be employed. Instances of this sort of thing are very numerous among readers whose financial resources are so limited as to prevent the acquisition of much in the way of workshop equipment ; they may be formidable obstacles, but they are the " straw " from which the " bricks " of achievement are made.

Honour for Mr. A. J. R. Lamb

● WE WERE very pleased to have a visit from Mr. A. J. R. Lamb recently ; he was making one of his rare trips to London from York, and took the opportunity to call upon us. He seemed very well and full of his usual energy, in spite of his eighty years, and among other things, he told us that he has lately been elected a Fellow of the British Horological Institute.

Mr. Lamb has always been very interested in clocks, and many readers may remember the beautiful long-case clock he built some years before the war ; it was, and still is, one of the finest examples of amateur clock-making that we know, and when it was entered in the " M.E." Exhibition in 1934, it won the highest award in its class—to wit, the Championship Cup. It was described and illustrated in our issue for October 11th, 1934, and there can be little doubt that it has contributed in no small measure to the honour just bestowed upon its builder.



A Model " Penang "

● OUR READERS will be interested in the photograph which we reproduce on this page showing a working model of a typical cargo-passenger liner, made by Mr. E. G. Lucas, of Harrow, and exhibited at THE MODEL ENGINEER Exhibition last year. In full size, this type of ship is increasingly popular, and many travellers prefer it to the large luxury liners, as, having accommodation for only twelve passengers, there is a much more intimate and friendly atmosphere, especially to those who love the sea and sailing for its own sake.

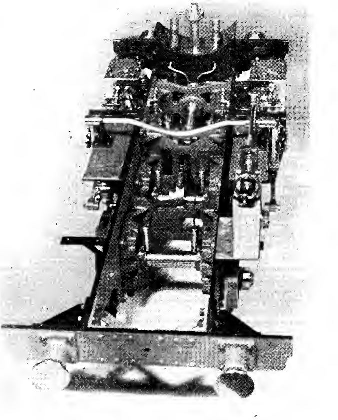
As a prototype for a model, such a ship has the advantage that it can be built to a larger scale than is usually possible with the model of a large passenger liner and, in addition, there is not the wearisome amount of repetition work in the matter of lifeboats, davits, windows, ventilators and such-like details. Mr. Lucas's model was built to the drawings and instructions published in our pages during the latter half of 1947 in a series by Mr. Leonard Sharp entitled " A Model Cargo-Passenger Liner, *Penang*." The model is 36 in. long and includes a very satisfying amount of detail. Moreover, this detail is sufficiently robust to be able to stand up to the wear and tear of sailing it on a pond.

The Hastings Modellers Association

● THE TENDENCY for model engineers to " get together " is steadily growing, and the latest example of it to come to our notice is at Hastings, Sussex. Mr. T. Bridgland, of the local Model Power Boat Club, informs us that an association with the above title has been formed out of the model engineering society, power boat club, model racing car club, and model aircraft club all existing in that town. Each club retains its separate identity and independence ; but all combine their activities as an association when necessary. This scheme seems to work very well, with mutual advantage to all concerned, and we expect to find it extended to other localities.

The Original 5-in. Gauge L.M.S. "2F"

by "L.B.S.C."



Real locomotive engineering

JUST after I had posted off last week's notes, the promised photographs of Mr. T. Truett's 5-in. gauge "2F" engine turned up, so here are the reproductions as promised. If any reader cares to turn up the issue of this journal dated February 19th, 1948, he will find an outline drawing of the whole engine, and sectional drawings of the boiler, made by Mr. Truett when he was on holiday during the previous year; also a couple of pictures of the chassis, as it was at the time the notes referred to were written. Since that date, Mr. Truett, whose business as a master builder very severely limits his spare time, has made such fine progress, that the chassis is now completed and a very fine job it is. As I saw it on air test on Good Friday evening, I can vouch for its performance; and when the boiler—now in course of construction—is finished, she is going to be some engine.

Like myself, Mr. Truett believes in designing the engine for the work expected of it, following full size practice in so far as it will suit the size of the engine, and making the necessary alterations and amendments where it won't. For example, take a look at the pictures showing the arrangement of the engine between the frames; note the hornblocks, axleboxes, and cross staying. The hornblocks are substantial ribbed castings, with ample bearing surface for the sliding faces of the axleboxes; a very good feature in view of the traction stresses imposed by small wheels, all coupled, and powerful cylinders. The cross stays really *are* stays, being hefty flanged and ribbed castings. The middle one is a specially "Bill Massive" affair, slotted to clear the eccentric-rod driving the pump. Its fellow-conspirator in front, which actually carries the pump, is a very close relation.

The driver of the engine won't have to worry himself about hot boxes, for each axlebox has its own separate oil container, filled via a small pipe leading to an oil cup at the leading end, accessible to the spout of the said driver's bosom companion. The three oil cups each side, are set in a piece of angle bolted to the frame, level with the top. Similar cups are fitted to the big-ends and coupling-rod bosses; and a slight variation, to the link trunnions.

"Hielan' Lassie" Helped!

The cylinders are similar to those of the "Lassie," but altered to suit the size of the engine, with my recommended sizes of ports and valves. The valve-gear is also based on the "Lassie's" valve-gear, the only alterations being those necessary to suit the different size and type of locomotive; but it is more elaborately finished off, having fluted rods. The radius-rods are lifted and lowered by a link behind the expansion-link, similar to the arrangement on the Maunsell 2-6-0's on the Southern; but unlike the latter, the lifting arms point toward the front of the engine, so that she uses the lower half of the expansion links for forward motion, and goes the same way as the inclination of the reverse

arm. This is actuated by a wheel and screw, shown temporarily mounted on a block of wood in the photographs. When the superstructure is made and erected, it will be properly fixed in the cab.

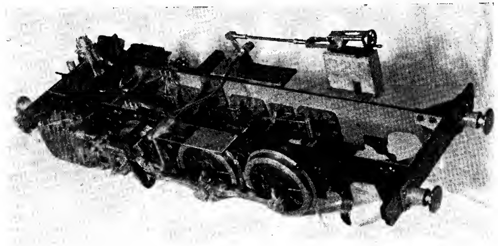
The mechanical lubricator is the same as I specified for the "Lassie," as each cylinder has a separate steam pipe, and also a separate oil pipe coming from the twin check-valves on the lubricator. These pipes can be seen going through the back of the smokebox saddle. A combined blast nozzle and blower is fitted, with three "teat" type blower jets. Brake blocks and hangers have been made and erected, but the actuating gear is not ready yet; this will consist of a powerful steam cylinder plus the usual rigging.

The boiler is being made according to the drawing in the issue referred to above; and as it embodies four superheater flues, the steam should be good and hot, and the engine very efficient. The workmanship of the whole bag of tricks is, as I remarked before, first class, and the locomotive should go as well as she looks. Our friend certainly knows how to build something else besides houses—and if his houses are up to the standard of the locomotive, the occupants are fortunate indeed! Incidentally, he won't have any difficulty in putting up the "architectural" part of his railway, and in that respect I must confess to a feeling of great envy; my own line is beginning to feel the effects of some thirteen years of British climate, and the longitudinals need replacing at several points. I wish they were steel girders! However, the line still carries plenty of heavy traffic, so we must be thankful for small mercies. A similar engine is being built as a club job by some of the workers at a Surrey aircraft firm; I understand that Mr. Truett lent them his special patterns to obtain their castings, and supplied the necessary information. Hearty congratulations on a fine piece of work, and a special "pat-on-the-back" for Mr. A. C. Angell, of the Croydon S.M.E. who took the photographs.

A Little Steam Goes a Long Way

On a recent fine Wednesday afternoon, two of the Romney, Hythe and Dymchurch engine-drivers, Messrs. Barlow and Hobbs, took a busman's holiday on my little railway. After inspecting the "works" and the "running-shed," they tried their skill at driving the Brighton single-wheeler "Grosvenor," and were amazed at the way the boiler steamed with a blast that was inaudible, once the engine got under way; also with the absence of any slipping. But they were more astonished still, at the performance of the *ex*-Carson L.N.W.R. 4-4-0 "Sybil," now in her thirty-eighth year of existence. It may be recalled that I rescued this engine practically from the scrap-heap, rebored the cylinders, fitted the "Curly special" ports, valves and valve-gear (Joy) and made a coal-fired boiler for her, with a racy-looking front end—smokebox on a saddle, and a stovepipe chimney. The cylinders are a shade over $\frac{5}{8}$ in. bore, and 1 in. stroke, driving wheels $3\frac{3}{8}$ in. diameter; and the boiler has a barrel $2\frac{3}{4}$ in. diameter containing six $\frac{3}{8}$-in. tubes and one $\frac{5}{8}$-in. superheater flue. The grate is—hold your breath!—$2\frac{3}{4}$ in. long and 1 in. wide. The feed pump is only $\frac{3}{16}$ in. bore.

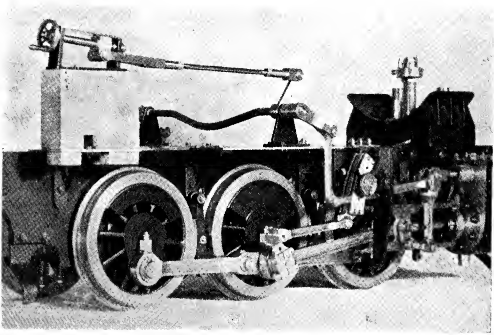
She was blowing off at 75 lb. in less than four minutes from lighting-up; the working pressure should be between 85 and 90 lb. on account of the small cylinders, but the safety-valve spring needs renewing, and as she has done all I need with the lower pressure, I have not so far bothered about fitting a replacement—got quite enough other things to attend to, anyway! I took her around myself for a few laps at an equivalent speed of over 100 m.p.h., notched up to kicking point, and blowing off with the pump feeding, then handed her over to the two enginemen, to put her through her paces, which they did in turn. Finally, both of them



Note oil supply to axleboxes

piled on to the one car, a load equivalent to 54 main-line bogie coaches (on four axles ! !) and the little black lassie marched off with them, without the ghost of a slip, rapidly attaining an equivalent speed of over 80 m.p.h. and holding it, with plenty of steam and water. While running, the pump feedbag split, and water started running out under the tender. The pipe was a bit of wartime tube, made of synthetic rubber, with longitudinal corrugations, and as soon as it becomes hardened, it splits down the corrugations on the slightest provocation. Anyway, Driver Barlow gave her a drop with the emergency hand-pump (she has never, so far, had an injector, as I was intending to make a special small one for her with a 0.011-in. delivery cone) and so they finished the run. The verdict was, that they wished their engines on the R.H. & D. were able to do the job in similar manner to the weeny $2\frac{1}{2}$-in. gauge locomotive. They are of opinion that the possibilities of the 15-in. gauge have never been fully exploited, and with that I fully agree.

Incidentally, had I taken on the job when offered, I would have had one of the L.N.E.R.-type 4-6-2's rebuilt to my own specifications with 7-in. cylinders, my own arrangement of valve-gear and setting, and boiler with combustion chamber, plus as many superheater flues as there were ordinary tubes ; mechanical lubrication, and a few other details. Such an engine would treat the " Bluecoaster " like so many boxes of feathers ; and builders of the engines I have described in these notes, will know that is honest truth, and no stupid idle boasting. I would also have had one of Jimmy Stirling's " F " class, externally correct, but with my own arrangement of " works " and boiler ; and I'm open to wager that the sight of that little reincarnation of the old South Eastern, puffing out of Hythe, on territory sacred to her big sisters of bygone days, would have brought acute nostalgia to those good folk, especially old enginemen, who have a soft spot in their hearts for old-timers. Also, tell it not in Gath, the historical and sentimental value would have been great, but the advertising value even greater ! Anyway, Messrs. Barlow and Hobbs departed for home, much impressed with what could be done on a small amount of steam ; and they want to come along later and have another go !



" The other side of the picture "

On the following Saturday, an old personal friend, Mr. G. Morgan, of Chichester, drove " Grosvenor " $1\frac{1}{4}$ miles without touching the fire, during which the crosshead pump, which has a $\frac{1}{8}$-in. diameter ram, sent the water right out of sight in the top nut, and he had to open the by-pass valve—an indisputable proof of the small amount of steam required to haul a load equivalent to 300 odd tons, at well over a mile a minute.

A Chance in a Million

The other afternoon I saw something which I have never before seen during the nineteen years I have lived here, and shall probably never see again. An " N " class Maunsell 2-6-0, on the up main, with a train of reconditioned steam

stock from the carriage works at Lancing, was just stopping for signal. A Brighton "K" class 2-6-0 was approaching on the down relief road with a goods train, taking very little notice of a big load, and taking the bank as if it were level. An old Vulcan 0-6-0 was drifting down the bank, tender first, with a load of empty wagons, on the up relief. The three engines met exactly opposite my old signal; and for one fleeting fraction of a second, they were all in line on their respective roads. Three steam locomotives meeting in line on a "Milly Amp" railway is, I should imagine, one of the most unlikely things one would ever expect to happen—but the old saying has it, that it is the unexpected which always happens! It certainly did in the instance mentioned. I never saw three engines meet opposite my garden in the old steam days, and only on two occasions saw two meet at that spot, so thought such a coincidence was worth putting on record.

Setting Valves Under Pressure

As I haven't quite finished the drawings of the tender for "Doris"—hope to have them ready for next instalment—let's have a word or two with correspondents. A new reader wants to know how the merry dickens he can adjust valves under steam; says he has tried it, and doesn't seem to have any luck. Well, one reason is, that he built his engine before he started reading these notes; and the valve-gear is made to a design that was renowned for its inefficiency. Best thing he can do, is to take the "Maid" and "Minx" gears as a guide, and rebuild his gear to half the size, his engine being a 2½-in. gauge job with link-motion. Having made quite certain that the valve cavities overspan the inner edges of the ports by a bare 1/64 in., and the laps at each end are equal, the procedure is quite simple, as follows, for cylinders without drain cocks.

Disconnect one end of the connecting-rod, or take it off altogether. Put the crank on front dead centre, and push the piston-rod right in, as far as it will go. Slack the set-screw of the fore gear eccentric, and put the reverse lever halfway between full gear and middle, on the forward side. Set the eccentric in step with the crankpin, and then apply air or steam pressure to the steam chest. Slowly turn the eccentric in a forward direction until the piston-rod shoots out, and the piston bangs up against the back cover. Tighten set-screw; then, with the pressure still maintained, turn the wheels by hand until the crankpin reaches back dead centre, when the piston-rod should shoot back again, and the piston hits the front cover. Note—if the piston-rod shoots back *before* the crank reaches dead centre, the valve is too short. If it doesn't shoot back until the crank has passed dead centre, the valve is too long. Repeat process on all four eccentrics; and, of course, turning the eccentrics and wheels backward, when setting the valves for what our nautical friends would call "going astern," and our transatlantic cousins call "backing up." When the piston-rod shoots out, or in, as the case may be, exactly as the crank passes the dead centres, the valve setting is correct, and the engine will do the job.

The same procedure is applied to setting Allan, Gooch, or any other gear employing two eccentrics, also to loose eccentrics; but in the latter case, turn the stop-collar, and let the shoulder of the stop-collar drive the pin in the eccentric. When the stop-collar is set-screwed to the axle, and the gear is O.K. for going ahead, turn the wheels backwards, and note if the piston-rod shoots in and out on dead centres. If it comes out before dead centres, take a little off the shoulder on the stop-collar, which engages with the pin. If the piston-rod lags behind the dead centres, the shoulder needs building up a little; and this can easily be done by soldering a little brass plate to it, thick enough to advance the eccentric sufficiently to open the port. A ring or bush can also be placed around the stop pin; but if this is done, the valves will want resetting in the forward direction, as the increased diameter of the pin naturally affects the setting in both directions.

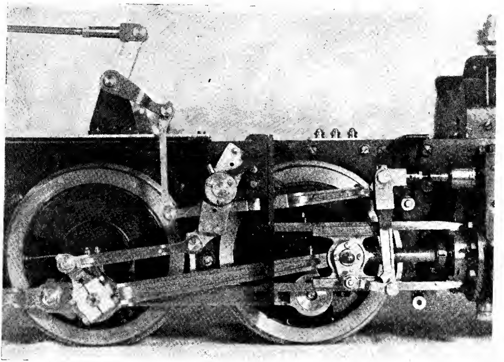
Walschaerts, Baker, Joy or any other radial gear which derives all or part of its movement from the connecting-rod, cannot be set under pressure by the "moving-piston" process, as uncoupling the connecting-rod cattles up the whole works right away; and the best way of doing the job with these gears, is to open the drain cocks, if any are fitted. If not, the only thing to do is to slack off the cover screws sufficiently to allow steam to blow past the gaskets. I have already described, umpteen times and then some, how to set the return crank, and get the correct length of eccentric-rods, with a pair of dividers; and the only remaining adjustment is the position of the valve on the spindle. Apply pressure to the steam chest; put the lever in mid-gear, then turn the wheels by hand. If steam or air, whichever you are using, doesn't blow from the cocks, or covers, as each crankpin comes on the dead centre, adjust the valve on the spindle until it does. If steam blows from one end, and not the other, the adjustment is obvious. If steam doesn't blow at all, the valve is too long. If the blow takes place much before dead centre, and continues to blow until the crank has passed the dead centre to a corresponding amount, the valve is too short.

The above adjustments should give good average results, and the engine should start readily, run notched up, and use only a small amount of steam. It should, however, be remembered that locomotive engines are like automobile engines in one respect, viz. they can be "tuned up" individually, to incorporate "that little bit of something that the others haven't got," and the performance made even still better. In the old days on the L.B. & S.C.R., when every driver had his own engine, and it was worth ten shillings for anybody else even to take a good look at her, let alone handle her, valve setting for economical running, was reduced to a fine art; and a driver who couldn't take a decent whack of "coal money," was reckoned very small potatoes by the other drivers in the same link. As our 'Oxton friend Bert Smiff would remark, "Gorlummy, them was the days!"—yes, and not only for coal money, but for low maintenance costs. The coal money paid out to the drivers, was saved many times over by the low upkeep expenditure.

"Blow-back"

Several of the newer followers of these notes have been rather mystified about the cause of the sad fatality near Coventry, when the driver and fireman of a Birmingham-Northampton train were set alight by flames coming out of the fire-hole door. The usual garbled accounts appeared in the daily Press, about "dynamite in the coal," "excessive steam pressure in the firebox," and so on and so forth; why on earth is it that the newspapers (accent on the "news"!) always get in such a shocking tangle when it comes to recording some simple bit of technicality? I well remember one famous daily, with a circulation of over three million copies per day, solemnly assuring its readers that by leaving off the running-boards on the Southern Q1 goods engines—the most awful nightmares ever put on rails—there had been a saving in weight of 20 tons per engine!

What happened on the L.M.S. engine was just this: for some unexplained reason, the driver omitted to open the blower-valve before shutting the regulator; and as soon as the exhaust steam ceased to come out of the blastpipe, the rush of air down the chimney, blew the flames out of the firehole door, and did the damage. There is no natural draught on a modern engine with a short chimney; and even on the old Brighton engines, with comparatively long chimneys, the blower always had to be put on before shutting the regulator. Although the flames did not blow out through the door with violence enough to cause a fatal accident, they came out plenty enough to make things uncomfortable, and it was very seldom a driver "forgot the ritual."



Close-up of "the works"

On a little engine, one sometimes gets a "blow-back," but the firehole doors are usually kept shut, and not enough can come through the air holes in the door, to do any damage. However, the blower valve should always be opened before shutting the regulator, for the simple reason that the body of fire is usually so small, that it would die down and go out without artificial draught. As stated above, there is no natural draught on a modern *full-size* engine, yet some folk would have us believe that the fire in a little one can be kept going without the aid of a blower. On a 5-in. gauge engine, or one of 3½-in. gauge with a wide firebox, the fire might stay alight for a few minutes after shutting the regulator, but that is all. I might add that when running, it isn't the *amount* of steam that goes up the chimney, that "keeps the home fires burning," but the *speed* at which it leaves the blast nozzles; which accounts for the free steaming of "Grosvenor" and "Jeanie Deans."

A Working Model Traffic-Light Signal

by George V. Gould

THE model traffic-light signal described here makes an excellent gift for any boy, can be easily made from scrap material in a few hours, and operates in a realistic manner. It is built approximately to scale, and is fed from either a 4½-volt dry battery or from an ordinary bell transformer.

The four lamp units are constructed from tinplate to the dimensions given in the "exploded" Fig. 1. The lampholders used in the model shown, were obtained from a discarded Christmas tree set; but if these are not available, small M.E.S. holders may be obtained and soldered in position. The lampholders should be wired, and the wiring taken through a hole in the top of the lamphouse, before soldering the two pieces of each unit together. It is only necessary to run one wire to the insulated "pip" of each holder, as the return current is conducted through the frame, via the soldered joints. Three small hoods are now cut, shaped, and soldered to each unit.

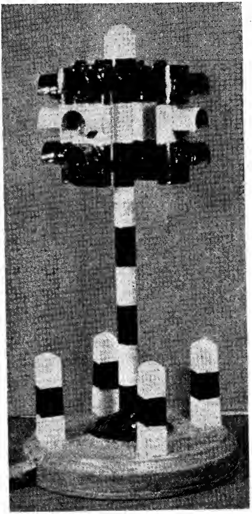
The support arms to carry these units are constructed from a piece of ¼ in. diameter brass tubing. Eight lengths are cut, each 1 in. long, two of which are soldered to the back of each lamp unit, spaced ½ in. from the tops and bottoms respectively. The four units are then soldered at equal distances around the main standard, the upper support arm again being spaced ½ in. from the top. This main standard is made from a 9½ in. length of ⅝ in. diameter brass tubing.

The base is a 7 in. diameter block of wood, 1 in. in thickness. A hole is bored through the centre, so that the ⅝-in. tubing will form a tight fit within it. If the tubing can be threaded, and a metal plate screwed on to it as shown in Fig. 2, this will make a stronger job; but failing this, the wedge fit will be found to serve very well.

The wiring is now carried down through the standard, led along a groove cut in the base of the block, and out through a hole drilled in the edge. At this point, a further wire should be soldered to the tubing, and carried out with the other leads in order to provide a common return to the lampholders. A disc of plywood is then pinned and glued to the underside of the block, in order to cover in the wiring. A cap can now be made from tinplate or wood, to form a tight fit over both wiring and tube at the top of the standard; or, better still, if a lathe is available, one may be turned from brass.

The standard is now complete, but for the four posts. These are constructed from 3 in. lengths of ¾ in. sq. wood; each tapering slightly towards the top, and finishing with a point; then glued in position around the base.

The switch assembly is built as a separate unit, and the connecting leads between it and the



traffic signal may be 3 or 4 ft. long. It is wired to change the lights in the correct sequence. This is Red; Red-Amber; Green; Amber; and then back to Red again. Reference to Fig. 3 and 4 will show that the switch contacts consist of four semicircular strips of thin brass. The rod carrying the operating knob, also has soldered to it a flat strip of springy brass, cut and bent as shown. A ratchet wheel should also be cut from flat metal and soldered to this rod, in order that a pawl engaging the teeth will prevent the rod being turned in an anti-clockwise direction, and

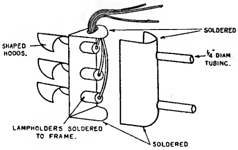


Fig 1

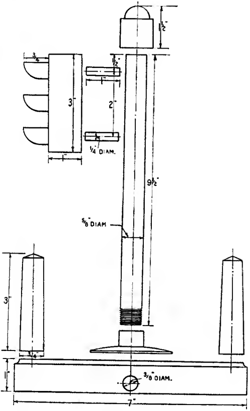


Fig. 2

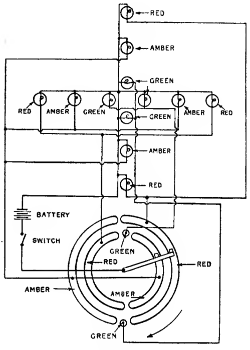


Fig. 3

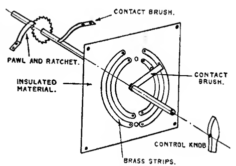


Fig. 4

so causing the lights to operate in the wrong sequence.

A further piece of springy brass is cut to form a brush contact, bearing on the spindle to complete the circuit. The complete wiring diagram is shown in Fig. 3. After connecting the control switch, it may be built into a suitable box, which can also contain the 4½-volt dry battery, or a bell transformer operating on the 4-volt tapping. A small toggle switch is also incorporated in this box so that all the lamps may be switched off when not in use. 3.5-volt bulbs are used in the lamps, and these can be coloured with ink or water-colours. It will be found that the latter gives a realistic matt finish to the bulbs.

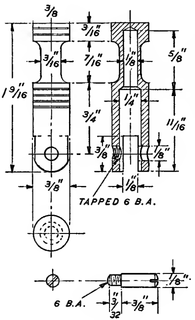
The whole model is now given a coat or two of white enamel, and when this is dry, the black bands are carefully painted in to conform with standard practice. The base is given an effective finish by applying a thin coat of glue, and then sprinkling with fine sand. This gives a gravel-like appearance.

*UTILITY STEAM ENGINES

by Edgar T. Westbury

STAINLESS steel is recommended for the piston-valve, which is externally lapped to fit the bore of the valve chest with the minimum possible clearance. If a bronze valve chest is used, the clearance will tend to increase when the engine is hot, but if the coefficients of expansion for bronze and stainless steel are worked out, it will be found that the actual increase is much smaller than is commonly believed. The control edges of the top "land" on the valve may be left longer each way for final checking up and setting after assembly. Fine grooves are turned in the working surface of the valve to assist in oil distribution and improve the pressure seal. The slot in the lower end of the valve, to take the small end of the eccentric strap, may be milled in the lathe, by holding the valve on a vee packing strip in the tool-post, interposing copper or aluminium packings to avoid bruising the finished surface, and using a circular saw or slotting cutter.

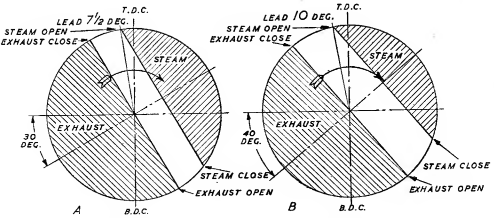
It would not be impossible to provide some means of adjusting the position of the piston-valve, by making the fork end separate and screwing it into the valve, but such methods often cause trouble in high-speed engines, and inevitably increase the weight of the valve assembly. Reciprocating weight in any of the working parts is always a cause of power loss at high speed, and in this case it has been considered best to keep the valve as simple as possible and make it hollow to reduce the weight to the minimum.



Piston-valve and wrist pin

When checking up the valve timing on assembly, the distance from the top edge of the valve chest to the top of the annular port should be carefully measured with a depth gauge. The eccentric is then set exactly at half stroke, when the top of the piston-valve should just coincide with this port edge, and if any error is found, it should be corrected right away. It is rather difficult to apply a positive check to the inside admission edge of the valve, but if the eccentric throw is correct, its position may be measured from the top of the valve when this is correctly located. The lower edge of the waisted portion of the valve does not

*Continued from page 667, "M.E.," June 2, 1949.

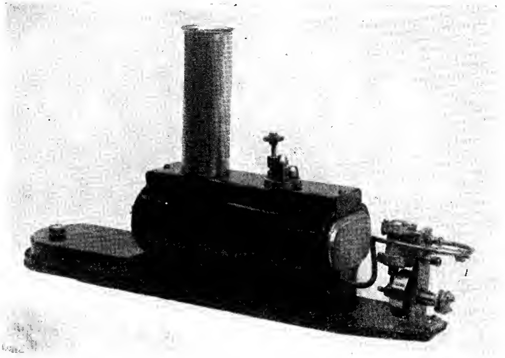


"A," *General-purpose timing diagram, with 30-deg. angle of advance and 3/64-in. steam lap;* "B," *high-speed timing, with 40-deg. angle of advance and 1/16-in. steam lap*

control any events, and its position is, therefore, unimportant, so long as it clears the steam inlet to the valve chest at all times while the steam port to the cylinder is in action.

Correction of errors in port timing may be made by machining away the valve as described, or by altering the vertical location of the cylinder-head, such as by packing in the cylinder-head joint, or by skimming away the joint surfaces. Two timing diagrams are shown, one for general purposes, using a normal angle of advance, and the other for maximum economy at high speed and high steam pressure, the angle of advance being increased, and also the steam admission lap, thereby giving an earlier cut-off, with a longer period of expansive working, also earlier exhaust release, and earlier exhaust closing, with greater compression or "cushioning." This will render the engine less docile, and possibly less powerful on the lower ranges of speed, but it will produce more power at high speed on limited steam consumption. If the uniflow ports are retained, they may with advantage be reduced in depth, and it is not desirable to make them open earlier than the point at which the piston-valve opens to exhaust.

Apart from the fact that some leakage of steam is practically inevitable in small piston-valves, and increases as the working pressure is raised, they suffer from the inherent limitation of all slide-valves, in that any alteration in the timing of any event affects all the others, and I do not think they are capable of producing an economy comparable with that obtained with poppet-valves.



A typical commercial model steam plant, with d.a. oscillating engine, and spirit-fired pot boiler

Boiler Design

In the foregoing descriptions of various types of engines, the importance of economy in steam consumption has been consistently emphasised. Obviously, it is equally important to ensure that the steam is generated in the most efficient manner, and the question of boiler and burner design, therefore, cannot be disregarded, in view of its influence on the success and efficiency of the plant as a whole. Generally speaking, it is far more difficult to generate steam than to utilise it, and many good engines are let down by the inadequacy of their boilers, or methods of firing, to supply their needs.

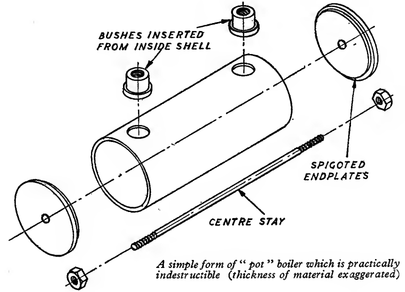
Not a Complete Unit

Many enthusiasts, who make a great point of the inherent simplicity of the steam engine, very conveniently forget that the engine itself is not a complete self-contained power unit, any more than is a compressed air engine or an electric motor, but simply a "power converter," relying upon an outside source for the supply of its essential working pressure, obtained either directly or indirectly from the combustion of fuel. In the case of the steam engine, the pressure generator is nearly always much larger and heavier than the mechanical unit, and it is clear, therefore,

that in all cases where the aim is to produce the maximum power in relation to bulk and weight, improvement of the boiler and burner will have more far-reaching effects than that of the engine.

There are, it is true, many model steam plants in existence having boilers of crude and inefficient design, yet capable of giving results quite satisfactory for their intended purpose, and what is more, with complete reliability. In some types of model prototype boats, for instance, where only "scale" performance is called for, quite a low power/weight ratio of plant will suffice, and attempts to step up efficiency may even defeat their own purpose by making the plant as a whole more difficult to handle, and temperamental in behaviour. But the outlook in respect of model power boat design, especially where any kind of competition work is intended, is gradually changing, and the modern tendency is towards steam plants having a higher power/weight ratio. In many cases where existing steam plants have failed to give the desired results, or where attempts to improve them have proved to be unsuccessful or unsatisfactory, the steam plant is often superseded by petrol or compression-ignition engines.

Readers may conclude that, as an ardent advocate of the internal combustion engine in all its forms, I ought to be highly gratified at such a development; but while I always like to see an engine of this type installed in a suitable boat, some of the modern examples are completely out of character, and it is clear that the constructor has simply taken the line of least resistance, and used the engine most ready to hand, to save trouble in construction and installation. I always hate to see an engine used simply as a means to an end; it may be a reflection of the austere and utilitarian age in which we live, but model engineering was not, nor ever could be, built on these principles, and it can only survive while engineering interest and love of good craftsmanship is given precedence over mere expediency. Many of those who run model power boats will agree that a reasonably sound i.c. engine of any type is less trouble to run than a steam plant; but few will assert that it is more interesting. The model power boat and the locomotive appear, according to present indications, to be the last strongholds of the steam engine, and I, for one, should be very sorry to see them ousted from either position. I have not in any way changed my views about i.c. engines, and I am just as enthusiastic about them as ever, but let us apply them in their proper place, and to enhance the interest of good models—not, as so often happens, to engender a deadly monotony of stereotyped and uninteresting power plants.



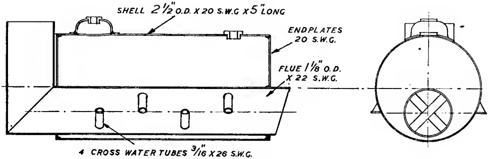
A simple form of "pot" boiler which is practically indestructible (thickness of material exaggerated)

The "Pot" Boiler

This term is usually applied to the simplest form of boiler—virtually a plain water container and nothing else—and is a relic of the good old days when steam was young, and boiler development had progressed but little from the domestic cooking pot or washing "copper." In model practice, pot boilers are usually cylindrical in form, and arranged horizontally over the burner, which is usually a methylated spirit lamp or simple form of vaporising burner. A casing is generally provided to enclose the boiler partially or completely, and in some cases heat insulation, in the form of an asbestos lining, is provided to concentrate all available heat on the boiler shell.

In this form, the pot boiler has formed the basis of innumerable miniature steam plants, mostly of commercial manufacture—and will probably feature in a good many more. It serves

its purpose where only a very modest rate of steam generation is required, though clearly its efficiency is very poor, due to the very small amount of heating surface in relation to its size. For the beginner in model steam engine construction, it is by no means to be despised, not only because of its simplicity, but also because it can be made strong enough to stand up to normal use, and even abuse, with complete safety. I have tested home-made boilers of this type up to pressures far in excess of those ever likely to be attained under normal working conditions, even if the engine should stop and the safety-valve jam! If the construction of the boiler is such that it does not rely on the soldered joints for strength, it can be boiled dry without suffering any further damage than a slight leak. I recommend that the end-plates should be provided with flanges or turned rims, and a rod with screwed ends passed through the centre to act as a stay; the fittings, such as filler plug or steam outlet bushes, should be provided with a rim at the lower end and inserted from the *inside* in close fitting holes in the shell, prior to fitting the end-plates. All contact surfaces should be well tinned before assembly, and the parts sweated together with the minimum amount of solder. Never expect solder to fill up holes or gaps, or leave lumps of it on joints with the idea of providing strength; but a neat fillet in the corners is desirable on the grounds of appearance.



A typical centre-flue boiler, as made by British Industrial Model Services Ltd., Bournemouth

Silver-soldering

It is, of course, still better to silver-solder all joints, using the same form of construction as before; the boiler will not be any stronger in resisting high pressure, but it is possible to heat it almost to a dull red—certainly hotter than it can ever get when using a spirit lamp—without deterioration of the joints. Silver-soldering is not a great deal more difficult than soft-soldering, provided that suitable means are available for producing the much greater temperature necessary; but if one is going to use this method, it is just as well to go to a little more trouble in producing a more efficient design of boiler.

A test was recently made of a soft-soldered boiler, having a shell of 22-gauge copper tube $1\frac{1}{2}$ in. diameter by 5 in. long, and 16-gauge copper end-plates spigoted to fit inside the tube, with a $\frac{1}{8}$-in. centre stay secured at the ends with 6-B.A. nuts. At 450 lb per sq. in., perceptible bulging of the shell took place, but no signs of failure at any of the joints. When boiled dry, using a three-wick spirit lamp, none of the soldered joints were permanently affected, though the solder in all of them was liquefied by the applied heat. A boiler of this size, with spirit firing, would be suitable for steaming a single-cylinder, single-acting engine of about $\frac{7}{16}$ in. bore by $\frac{7}{16}$ in. stroke.

Centre-flue Boilers

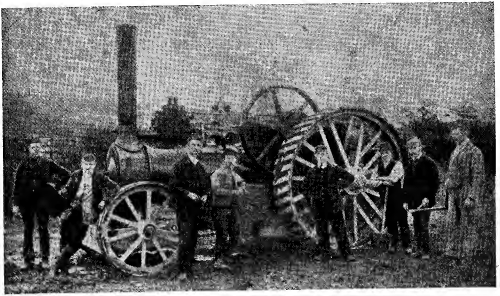
When steam engines first began to come into industrial use, the need was soon felt for increased heating surface, to increase fuel economy and also to reduce the size of boiler required for a given engine power. Although the desirability of using a large number of fire- or water-tubes was realised quite early, the practical difficulty of building complicated boilers, and of producing suitable tubes, prevented this being put into effect for many years, and the first developments in this direction consisted in building boilers with one or more internal flues, and in some cases incorporating the furnace inside the boiler shell, thereby utilising heat which would otherwise be wasted on the firebox casing. The most common examples of this practice were the Cornish and Lancashire boilers, and some large examples of this type are still in regular use.

In model practice, the use of a centre flue in a cylindrical boiler arranged either vertically or horizontally, was early found to be highly successful, and the latter arrangement has been perhaps the most popular of all boilers for model steamboats. Its construction has often been described in THE MODEL ENGINEER and practically all well-known model firms, including Steven's Model Dockyard, Bassett-Lowke, Stuart Turner, Bond's o' Euston Road, etc., have supplied ready-made boilers of this type and materials for their construction. The improvement in full-size internal-flue boilers by the addition of cross water-tubes, first instituted by Galloways, has been incorporated with equally good effect in model boilers, and is now almost the universal practice.

(To be continued)

An Old Road Locomotive

Mr. H. J. Wilburn recalls some memories of a Fowler traction engine, "Spider Legs," about 60 years ago



A reproduction from a very old photograph taken about 1899 of an 8 h.p. Fowler traction engine

I HAVE read with interest the articles in THE MODEL ENGINEER on traction engines and the photograph reproduced above is of one of three I had charge of in 1889. This is an 8-h.p. by J. Fowler & Sons, Leeds.

A few remarks concerning this particular engine may be of interest to some readers. It was used for carrying the 43 cwt. pipes from the railway to the works on the Thirlmere and Manchester Pipeline, a distance of four to nine miles. The usual load was four and six pipes on lorries. In top gear it could easily travel eight or nine miles per hour, and in low it was very powerful and could negotiate some very steep hills with ease. The other engines were very good but lacked the power of this one, especially on soft ground.

The roads at that time were not in the same condition as they are today. It was an old engine then but I cannot say how old. There was a number-plate but I cannot remember its registration number, and this is hidden in the photograph by the driver who is standing against it. He was at that time in his early twenties but was an expert at his job and was usually called if any of the other drivers were in difficulties. "Spider Legs," as the engine was christened, was always in demand to help them out. I may say that, in those days, a man was supposed to walk in front with a red flag, but as the roads were mostly by-lanes in the country, he was usually on the engine unless some farm horses were on the road. In this case he usually helped them past.

I must say I have been with traction and ploughing engines since the age of twelve and am now in my 84th year. I have handled nearly all makes but always had a warm spot for a Fowler, and have not the slightest interest in internal-combustion engines. I have been a reader of THE MODEL ENGINEER since it was first published in January, 1898, and, until recently, had No. 1 copy.

The Sheffield Exhibition

by E. D. Adams

THE Sixth Annual Exhibition of the Society of Model and Experimental Engineers, was held recently at the Junior Technical Schools, and proved a bigger success than ever.

During the four days of the show, upwards of 10,000 people visited the hall and once more the stewards were kept busy answering questions which were fired at them by the curious and the enthusiastic patrons.

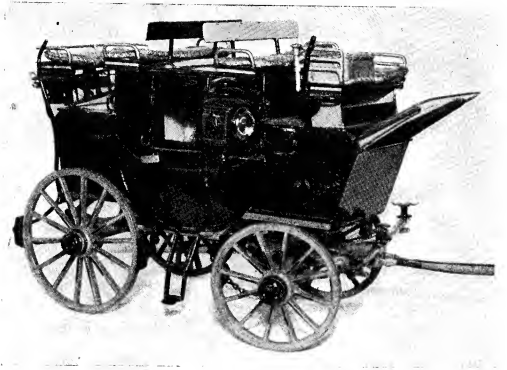
The exhibition was opened by Col. W. R. Stevenson, Senior Warden of The Cutlers' Company, after which, he duly tried his hand at driving Mr. R. Kerry's 1-in. scale locomotive on the passenger-hauling track.

From there on, everything went "with a swing." The aforementioned passenger-hauling track was a greater success than ever, the proceeds, which reached a record, were devoted to the Sheffield Newspapers' Fund for Holidays for Poor Children—a very worthy cause indeed.

The judges, Mr. E. T. Westbury, Lt.-Com. J. H. Craine and Mr. W. Young of Sheffield, all acclaimed that the workmanship and finish were higher than ever—praise, which from these gentlemen, means a lot.

There were something like 200 exhibits on view and space does not allow mention of more than a few.

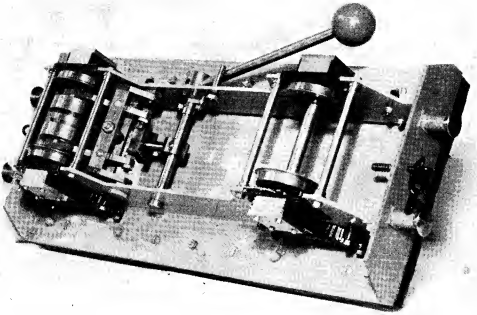
There was the truly marvellous 2-in. scale Fowler's Showman's Road loco by Messrs. C. W. and A. A. Verity, the beautifully finished "Hielan' Lassie" chassis by Mr. Law and his son and a host of other "good things."



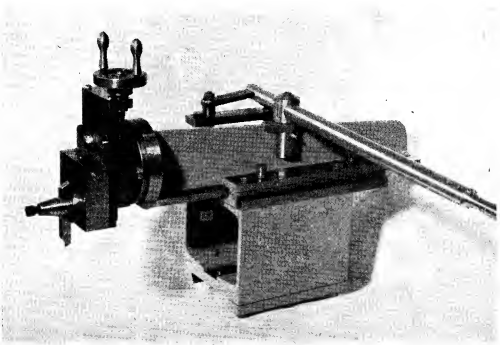
Mr. J. Tomlinson's model 18th century horse-drawn coach

Mr. Lowe's Showman's Road loco won the Open Championship Cup—remarkable how these beautiful old timers attract! The President's Cup was won by Mr. P. Thompson's "M.E." $3\frac{1}{2}$-in. gauge electric locomotive—another design "out of the past."

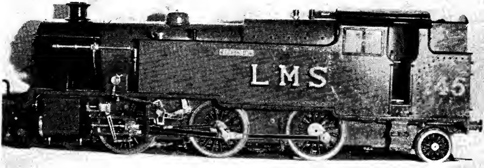
A note of humour was struck by a $\frac{1}{2}$-in scale "Austere Ada" to "L.B.S.C." design belonging to Mr. E. D. Adams in front of which was placed the same gentleman's "OO"- gauge replica. Mr. W. J. Hughes, of power boat fame (the Society wit?) had placed a card in full view appropriately endorsed "Mother and Pup."



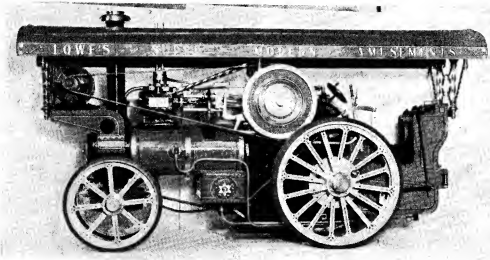
Underside view of Mr. Langley's ½-in. scale driving truck, showing novel brake gear



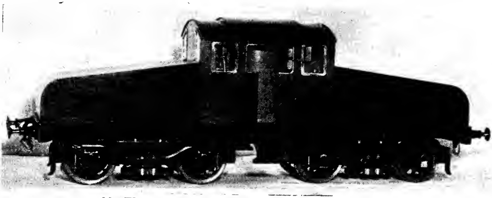
Mr. Langley's prize-winning hand shaper



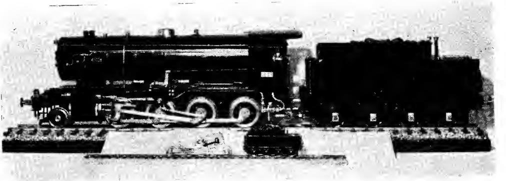
Mr. Breedon's 1-in. scale L.M.S. 2-6-2 tank locomotive



Mr. Lowe's cup-winning 1½-in. scale showman's road locomotive



Mr. Thompson's cup-winning 3½-in. gauge electric locomotive



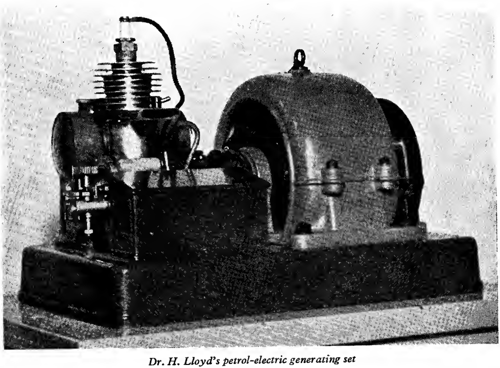
Mr. Adams's $\frac{1}{2}$-in. scale "Austere Ada," with a "OO" gauge replica in the making

Dr. H. Lloyd's petrol-electric generating set deserves special mention, in that the 2.5-c.c. engine was literally hacked out of the solid, and the whole is nicely compact.

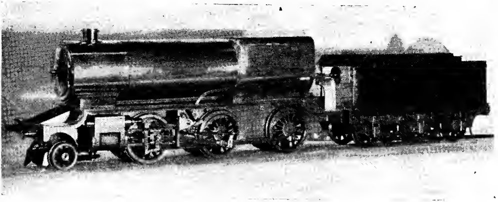
Another, deserving of special mention, is Mr. Copley's $\frac{1}{2}$-in. scale "Dyak," again to "L.B.S.C.'s" design, Mr. Copley is not a young man, is a clerk, and this is his first attempt, a very worthy one, if I might say so.

Incidentally, what a debt hundreds of proud owners of miniature locos owe to that grand gentleman "L.B.S.C."! I wonder how many lovely little live-steamers owe their existence to him—may he live long and design many more!

The prize-winning exhibit in the Workshop Tools Section was Mr. Langley's hand shaper for use in conjunction with a $3\frac{1}{2}$-in. Faircut lathe—a beautifully finished piece of work. The same gentleman entered a $2\frac{1}{2}$-in. gauge driving truck which was fitted with novel and perfectly working brake-gear. This was actuated by a double-cone clutch engaging a correspondingly coned bobbin mounted on the rear axle; the action is positive although the axle is fully sprung. I am trying to persuade Mr. Langley, with the Editor's permission to write an article for "Ours" describing this item in the near future.



Dr. H. Lloyd's petrol-electric generating set



Mr. Copley's first attempt—a ½-in. scale "Dyak"

Mr. Tomlinson's lovely replica of an 18th Century Stage Coach provided a wistful reminder of other days, of dusty roads and old posting houses, with ostlers, cobbled yards and good brown ale!

To many who saw the exhibition, perhaps the most imposing of all the entries was Mr. Breedons truly magnificent 1-in. scale L.M.S. 2-6-2 Tank loco. The finish which Mr. Breedon manages to obtain must be seen to be believed; the funny thing is, that if anyone compliments Sam, as we know him, on his work, he just replies, "Eh it'll do lad."

And there, for the present, I must leave you. Yes! it was a lot of hard work—organising and arranging—but then these Shows always are, but then, again, they are worth it, aren't they? and we all enjoy them, don't we?

Let's hope that next year will be bigger and better than ever.

Why Gauge "1"?

by Victor B. Harrison

MR. K. E. TRASK asks me, in his article on "Gauge '1' and Why" in the May 12th issue, why I went in for Gauge "1." There were many reasons, some of which I have given in my articles in THE MODEL ENGINEER; but definitely one of them was that, in that gauge, it is possible for the amateur to make very nearly everything himself, without having to be a watchmaker by trade. Actually, my original intention was 2-in. gauge, as at the time I was contemplating a model railway on which I could construct most things myself.

In 1910, when I started, the 2-in. gauge was already on the descent, while Gauge "1" was very much on the up-grade. One thing that did make me dither between the two gauges was that, at that time, the 2-in. gauge was considered the smallest scale for working internally-fired locomotives. I was one of those who blew that theory sky-high. I do not claim that I was one of the first to construct such an engine, but definitely I was the first to build a solid-fuel-fired engine in this gauge with a proper loco-type boiler. This was done with the help of the late Mr. Henry Greenly.

Since those days, both professionals and amateurs have proved that in Gauge "1" you can build anything, and it will not only work well but look the part. The final reason was that, for a reasonable layout, the garden is the place; and also, that instead of spending most of one's time indoors, and probably in an attic, one was forced to be in the fresh air. In the summer-time, one works on the line and there is plenty of time during the winter months to build locomotives or rolling-stock indoors.

Now a word of advice, Mr. Trask. Don't build all your line at ground level. There are reasons for my saying this. When traffic is opened on your line it is not very realistic to have an aeroplane-view of it all the time. Also, if the line or a train requires attention, you will get a bit tired of having to get on all fours to put things right. My line is all up on concrete posts, about 3 ft. 6 in. high. Along 75 per cent. of the line I have planted privet hedge, which hides all that. There is a small portion at ground level which looks very well, too.

One more tip, and that is install on your line the Courtice-Relph-Harrison steam locomotive control. I call it that because all three of us developed it. It will enable you to have gradients on your line with no fear of the engines taking the bit between their teeth and bolting on the down grades. Full particulars have appeared in THE MODEL ENGINEER during the past three years.

Those who have seen it in action remark that it is quite uncanny and that it looks as if there really were a driver on the footplate. Well, Mr. Trask, I wish you the best of luck in your venture, and I am confident that you will never regret your choice of gauge.

IN THE WORKSHOP

by "Duplex"

*39—Gear-cutting in the Lathe

THE method of making gear-cutters here described is that devised by Mr. J. Rodway, an eminent engineer who has, very kindly, not only given us full particulars of the processes involved, but has also granted permission for their publication.

While we have closely followed the original method, we have at the same time added some suggestions to make the work easier for those whose workshop equipment is limited. Furthermore, we have designed and made a simple type of honing jig to enable the cutters to be accurately sharpened where a cutter-grinding machine is not available.

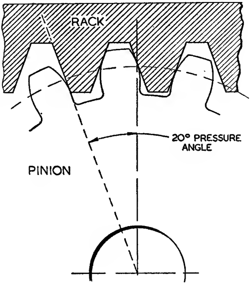


Fig. 1. Illustrating the pressure angle

As has already been pointed out, in ordinary workshop practice, gears are cut to only an approximate standard of accuracy as judged by the theoretical requirements; that is to say, a single cutter is used to machine wheels of several tooth numbers, over a small range, whereas to obtain the theoretically correct tooth form, a single cutter should be employed for each tooth number.

The system of gear-cutter production here described also departs from theoretical accuracy in both this and in other minor particulars; nevertheless, in practice, good results have been obtained, and the cutters made have produced gear wheels of good finish and having a highly satisfactory performance.

The cutters described are suitable for machining gear wheels of any diametral pitch and with any number of teeth, from 17 to a rack; the pressure angle specified is 20 deg.

A description of diametral pitch in relation to the number of teeth on the wheel has already been given, but a new term—pressure angle—has been introduced at this stage. Those who are interested in the geometrical considerations concerning the form of the involute tooth should consult a standard reference book on the subject, but to put it briefly, the pressure angle is the measure of the obliquity of the contact surfaces of the teeth of two gear wheels set in mesh, and it represents the direction in which pressure falls on the teeth when a load is applied.

The pressure angle is shown diagrammatically in Fig. 1, and for the sake of clarity and to avoid possible confusion from more elaborate geometrical construction, a rack geared to a pinion

*Continued from page 683, "M.E.," June 2, 1949.

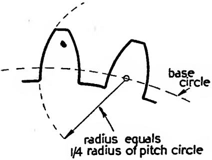


Fig. 2. Single-curve tooth form

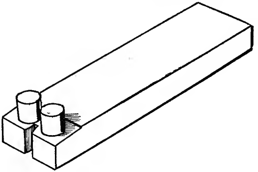


Fig. 3. The form-tool used for shaping the cutter teeth

is used for the purpose of illustration; for a rack here represents a gear wheel of infinitely large diameter.

The practical importance of the pressure angle is that, with the form of tooth used and with a standard angle of 14½ deg., 32 is the lowest number of teeth that can be used, without

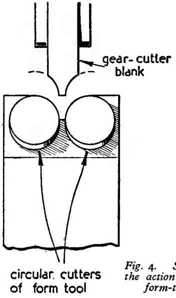


Fig. 4. Showing the action of the form-tool

undercutting the tooth flank, if interference between the teeth is to be avoided when the wheels are running together.

If, however, the pressure angle is increased to 20 deg., then a 17-tooth wheel, machined without undercutting of the teeth, will run in gear with a wheel of any other size. This 20 deg. pressure angle, in conjunction with a shortened form of tooth, is now largely used in automobile engineering, as it produces a stronger type of tooth.

in question is equal to a quarter of the radius of the pitch circle. In the present instance, the corresponding arcs on the teeth of the gear cutter are machined by means of a tool consisting of two circular cutters, of the appropriate radius, mounted at the correct distance apart in a suitable form of holder. The tool itself is depicted in Fig. 3, and its mode of action is illustrated diagrammatically in Fig. 4, where it will be apparent that the two circular cutters will form on the gear-cutter two similar segments of circles, representing the flanks of the gear teeth which it is required to cut.

In order to machine the teeth of the gear-cutter to the correct shape, it is necessary, in addition, to determine by calculation both the distance apart of the two circular cutters and also the distance to which this form tool must be fed into the work.

For reference purposes, these dimensions are set out in Table A, which shows that six cutters are required for machining the whole range of gear wheels of any one diametral pitch.

TABLE A.—Pressure angle 20 deg.

Cutter	Gears cut	Pin Diam. D. in.	Pin centres C. in.	Feed-in. E. in.	Cutter width F. in.	Back-lash in.
A	135 to rack	51.30	49.60	3.89	4.00	0.050
B	55 to 134	32.15	31.60	3.64	4.00	0.060
C	35 to 54	15.07	15.52	3.19	4.00	0.070
D	26 to 34	10.26	11.03	2.88	4.00	0.080
E	21 to 25	8.55	9.40	2.75	4.00	0.090
F	17 to 20	7.80	8.70	2.65	4.00	0.100

All the above dimensions relate to cutters of 1 Diametral Pitch; for other pitches, divide the values given by the corresponding diametral pitch.

The feed-in (E), determines the depth and thickness of the cutter teeth, and is measured

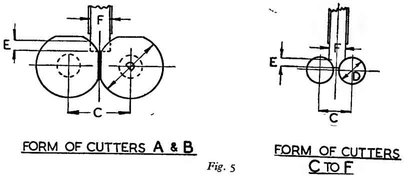


Fig. 5

Leaving out the geometrical construction of the tooth, it may suffice to say that, in the tooth form used in the cutters described, the flanks of the teeth are represented by a segment of a single circle as illustrated in Fig. 2; this is in accordance with the system described by Messrs. Brown & Sharpe, and the radius of the circle

from the point where the pins of the form-tool make contact with the cutter blank.

The dimension (F), represents the breadth of the cutter blank, and serves as a datum dimension when engaging the form-tool.

The backlash is the extra depth given to the teeth when using the gear-cutter to machine gear

wheels; this allowance takes into account the approximations involved where arcs of circles are used for the tooth face profiles.

All these terms will be further explained, and their practical application considered, when directions are given for making the form tools and gear-cutters, as well as when describing the actual gear cutting operation.

Relieving the Cutter Teeth

If, as in an ordinary turning operation, the teeth of the gear-cutter were machined to shape with the form tool described, the gear-cutter would then be unsuitable for machining the teeth of a gear wheel, as it would have no clearance behind the cutting edges such as is given to all lathe tools.

Now, this clearance must be given to both the side and front cutting edges of each individual tooth, and moreover, it must be so formed that the cutter will continue to cut accurately-shaped teeth after it has been resharpened in the manner later described.

This clearance, relief, or back-off can be machined on the cutter teeth in two ways; either, as in a relieving lathe, the slide carrying the form tool is actuated by a cam to move the tool inwards and outwards against each tooth in succession as the work revolves, or the form tool is fixed in position and the work is made to oscillate and at

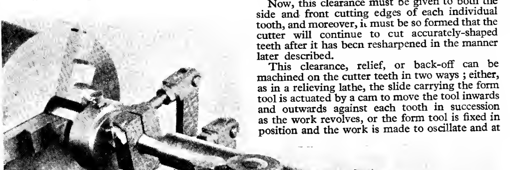


Fig. 6. The attachment set up for machining the cutter blank

Where gear wheels having less than 17 teeth are required, the pressure angle must be correspondingly increased to enable the gears to run together without interference between their teeth.

The new values applicable to these wheels are given in Table B.

TABLE B.—Pressure angle 30 deg.

Cutter	Gear Teeth	D. in.	C. in.	E. in.	F. in.	Back-lash in.
A	135 to rack	67.5	59.5	3.20	4.0	0.05
B	55 to 134	27.5	25.0	2.85	4.0	0.06
C	35 to 54	17.5	16.3	2.67	4.0	0.07
D	26 to 34	13.0	12.4	2.54	4.0	0.08
E	21 to 25	10.5	10.25	2.41	4.0	0.09
F	17 to 20	8.5	8.5	2.31	4.0	0.10
G	14 to 16	7.0	7.2	2.18	4.0	0.10
H	12 & 13	6.0	6.36	2.06	4.0	0.10
J	10 & 11	5.0	5.6	1.98	4.0	0.10

the same time to move towards and then away from the form tool.

In the system adopted the latter method is used, that is to say the form tool is fixed in the lathe toolpost and the cutter blank is mounted eccentrically on an arbor carried between the lathe centres; when, therefore, this arbor is turned to and fro, the blank will move alternately towards and away from the tool.

In the present instance, as illustrated in Fig. 6, an eccentric is fitted to the lathe mandrel, and a link attached to the strap of the eccentric is used to rock the work backwards and forwards while turning it for a small part of a revolution.

The effect of these movements is that the work is turned for a sufficient distance to machine a single tooth, and the inward and outward motion serves to cut the requisite amount of back-off. In this way each tooth, located by a register pin, is in turn correctly machined.

To amplify, and, perhaps clarify this description, reference should be made to the illustrations in order that the purpose and working of the several parts of the mechanism may be more readily understood. Fig. 6 shows how the cutter

relieving gear is mounted in the lathe; Fig. 7 illustrates the construction of the rocking mechanism; and Fig. 8 depicts the form of rocking arbor on which the cutter blank is mounted.

The general arrangement drawings are given in Fig. 9, and the attached numbers are applicable throughout the series of working drawings of the several parts of the mechanism.

A cross-reference, should therefore, enable any particular part to be identified and its dimensions determined.

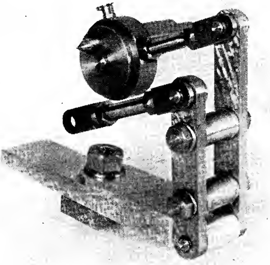


Fig. 7. Details of the rocking mechanism

The eccentric (1) is secured by its shaft in the lathe mandrel chuck or collet, and the eccentric strap is connected to a rocking lever (6) which is pivoted to the anchor block (9) bolted to the lathe bed. Attached to the rocking lever (6) is an arm (7) which is connected by a link (12) to the arm (4) secured to the cutter arbor (2).

The cutter blank is mounted on an eccentric seating formed at the end of the arbor, but the remaining portion of the arbor runs truly on the tailstock centre and on the coned centre, fitted centrally in the shaft of the eccentric.

It follows, therefore, that, when the lathe mandrel revolves, the eccentric causes the lever (6), and with it the lever (7), to rock to and fro, thus making the arm (4) rock the arbor backwards and forwards for a small part of a revolution.

The lengths of the levers concerned and the travel of the eccentric are so arranged that the cutter blank is turned for a distance sufficient for machining each individual tooth.

In addition, the eccentric mounting of the cutter blank on the arbor causes the cutter, as it is turned, to advance towards the form tool. It will be apparent that the combination of these two movements results in the machining of the heel of each cutter tooth to a lesser diameter than the cutting face, that is to say the tooth is relieved or backed-off and is thus enabled to cut freely when at work.

The Eccentric. Part 1. Fig. 10.

The body of this component is machined from a length of $1\frac{1}{2}$-in. diameter round, mild-steel bar. The bar is secured in the chuck to allow both ends to be faced true. Next, the work is clamped in a V-block resting on the surface plate and the cross centre-lines are scribed with the surface gauge at both ends; in addition, the subsidiary cross centre-line is scribed exactly $\frac{3}{8}$ in. below the horizontal centre-line to denote the throw of the eccentric. The centres indicated by the intersections of all these lines are then carefully centre-punched, and afterwards drilled with a small centre drill; the purpose of the latter operation is to afford centres for the wobbler, or centre-finder, which will enable the work to be set to run truly or with the specified amount of eccentricity.

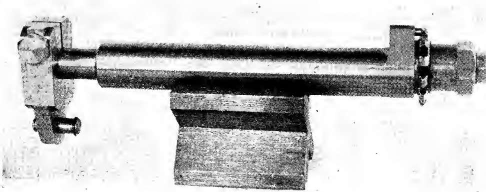


Fig. 8. The arbor fitted with its rocking arm. The cutter blank is shown in place

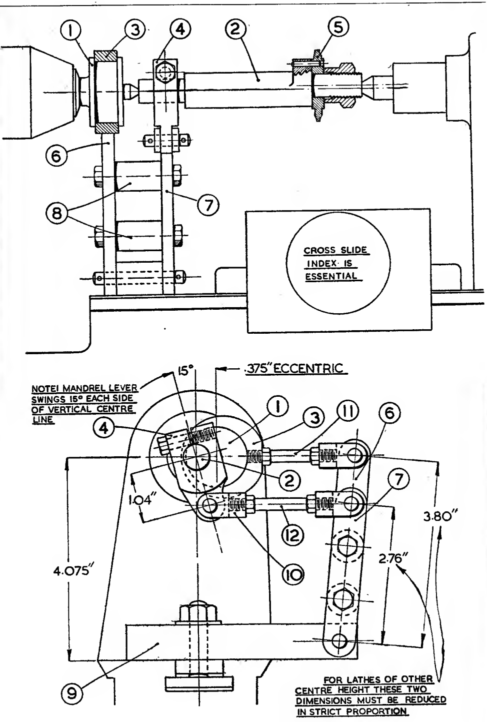


Fig. 9. General arrangement drawings of the attachment

Grip the bar in the four-jaw chuck, and with the aid of the wobbler set the true centre to run truly; reduce the overall diameter to 1 15/32 in. and turn the 1¼-in. diameter portion to receive the eccentric strap; drill the centre with a No. 24 drill and tap the hole No. 2 B.A. as indicated in the drawing.

The wobbler is then again used to set the work in the chuck so that the centre scribed ⅜ in. away runs truly; this allows the seating for the will depend mainly on the width of the lathe cross-slide, for the base to which the rocking gear is anchored is bolted to the lathe bed, and the cutter blank, when mounted on the arbor, should be in a convenient position for being machined with a tool secured to the lathe saddle.

The ends of the material are faced flat, and the work is then mounted in a V-block resting on the surface plate to enable the cross centre-lines to be scribed at both ends.

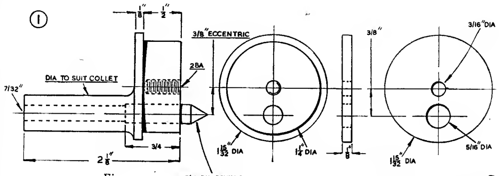


Fig. 10

KEEP PLATE FOR PART 1

coned centre to be drilled and bored in the correct position.

The coned centre can be fitted into a well-fitting parallel bore, or a taper seating as in the lathe mandrel can be used; alternatively, the centre can be provided with an abutment shoulder and screwed into place.

The work, when reversed, is gripped in the chuck by the 1¼-in. diameter portion to enable the shank to be centred with the wobbler so that it can then be reduced in diameter to ⅝ in. or so, or turned to fit a mandrel collet should the lathe be so equipped.

Where a pressed-in coned centre is used, it is advisable at this stage to drill a 7/32 in. diameter axial hole to meet the centre housing; this will enable the coned centre to be driven out when required.

The keep plate of the eccentric sheave can be turned and parted off from the 1½-in. diameter material used to make the eccentric body; the central bolting hole is drilled in the lathe at the time of the turning operation, and the clearing size hole for the passage of the coned centre is marked-out with the jenny callipers on the cross centre-line, and then drilled in the drilling machine.

The coned centre is made of silver-steel, and the coned portion is turned to an included angle of 60 deg. by setting over the lathe top slide. As this is a working centre, it should be hardened and tempered in order to resist wear.

The Cutter Arbor. Part 2. Fig. 11

A piece of 1½-in. diameter round mild steel is used for making this part, but alloy steel, such as that found in motor car axle shafts, can be employed for this purpose if better wearing qualities are required. The length of the arbor

The two centres shown at B—B in the diagram in Fig. 12 are then marked-out with the jenny callipers ⅜ in. from the periphery; this is to allow sufficient material for forming the web to carry the cutter driving-pin.

The two centres A—A are scribed on the cross centre-line at a distance of 0.09 in. from B—B.

Those who experience difficulty in attaining accuracy in marking-out operations will find this subject dealt with in *Marking-out Practice for Mechanics* published by Percival Marshall & Co.

As will be apparent, the arbor when mounted on the centres A—A will cause the cutter blank to run truly so that it can then be machined to the correct width; but when the centres B—B are used, the blank will turn eccentrically as is required for the operation of relieving the teeth.

When the four centres have been carefully centre-punched, their position should be checked with a hand lens before they are centre-drilled. As the paired centres are rather close together, it is advisable to employ a centre drill with a ⅛-in. diameter shank and a 3/64 in. drilling point.

It will be observed that the end view of the arbor given in Fig. 11 shows that the cutter driving peg is located at an angle of 15 deg. from the cross centre-line common to the two centres.

This angle is set out by attaching a 60-T wheel to the tail of the mandrel, but as 15 deg. equals 2½ teeth on this wheel, a 2 to 1 reduction gear is fitted to enable 5 wheel teeth to be used for the indexing operation. A 20-T wheel, gearing with the 60-T wheel, is, therefore, keyed to a 40-T wheel mounted on the same stud; five tooth spaces on the latter wheel will then give the required 15 deg. of rotation.

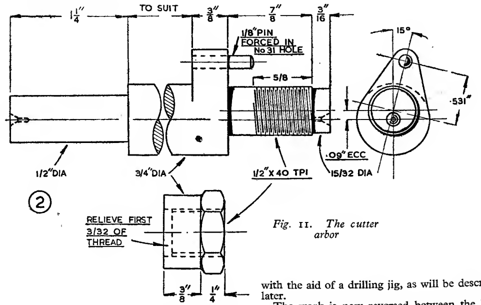


Fig. 11. *The cutter arbor*

The next step is, with the aid of the surface gauge, to set the cross centre-line on the end of the arbor to lie parallel with the surface of the lathe bed, and the quadrant detent is then adjusted to engage a tooth space on the 40-T wheel.

Mark the fifth tooth space from this point, as it will be required later when marking-out the position of the cutter driving-pin.

With the arbor still mounted on the centres A—A, turn the parallel portion on which the cutter blank fits to exactly 0.500 in. in diameter, with the aid of a drilling jig, as will be described later.

The work is now reversed between the lathe centres for turning the remaining portion of the arbor on the centres B—B.

The end portion of the arbor is reduced to ½-in. diameter for fitting the rocking arm (4), but the remainder is turned to ¾-in. diameter in order to afford rigidity.

For the sake of appearance, the web on the shaft lying at the junction of the turned portions is reduced by filing to the shape represented in the drawing, but this also serves to allow the arbor to fit into the cutter honing jig which will be described later.

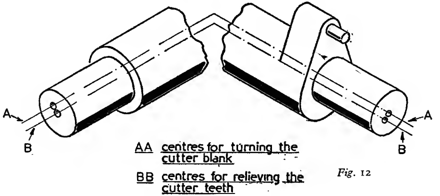


Fig. 12

and then screw-cut it 40 t.p.i. for a distance of ⅝ in. to receive the clamping-nut.

Next, engage the detent with the tooth space previously marked on the 40-T wheel, and with a V-tool, set on its side at centre height, scribe the centre-line for the driving peg on the face of the web ; the hole to receive this peg is drilled

The clamping-cut can conveniently be turned from a length of ¾-in. Whitworth nut-size hexagon bar, and following the turning and boring operations, the thread can be cut with a tap supported by the lathe tailstock while the work is still gripped in the mandrel chuck.

(*To be continued*)

The Kent S.M.E. Regatta

ALTHOUGH the date of this event was somewhat early in the year, quite a good turnout of boats was seen at the Kent S.M.E. regatta held at the home water of the Blackheath club, the Princess of Wales pond.

This was the first M.P.B.A. regatta of the season and also the first full event to be held by the Kent society. Support was forthcoming from the Blackheath, Victoria, S. London, Orpington, Malden and the new Kingsmere club, and a large crowd of spectators who remained at the pond-side all day.

A 50-yd. nomination race for straight-running craft was the first event and attracted some 14 entries. A pleasant surprise was the reappearance of Mr. Squires, of the Malden club, with his steamer *Comet III*. Good runs were made by most of the boats and the result was as follows :—

1st. Mr. B. Whiting (Orpington), *Ann*, 4 per cent. error.

2nd. Mr. Curtis (Victoria), *Micky*, 5 per cent. error.

A short lunch interval followed and upon a check-up of the round-the-pole racing boats present, it was decided to make a nomination event for these racing craft, as there were insufficient boats in each class to warrant holding a proper race. In this event it was interesting to see the small hydroplanes of the Kingsmere club in action. Quite high speeds have been obtained with only 2.5-c.c. engines, and one of these won the race with a speed of 30.25 m.p.h., estimated time 22 sec., actual 20.5 sec. Second was Mr. G. Lines (Orpington), with a new boat, *Sparky*—a 15-c.c. two-stroke engined boat. Result : 300-yd. nomination race for hydroplanes :—

1st. Mr. Bunton (Kingsmere), 6.8 per cent. error.

2nd. Mr. G. Lines (Orpington), *Sparky*, 7 per cent. error.

The regatta concluded with a steering competition in which some good scores were made, no-one, however, scoring a maximum, a feat which has yet to be done on the Princess of Wales pond. The winner was the petrol launch *Micky*, owner Mr. Curtis (Victoria), and runner-up was Mr. E. Vanner's steamer, *All Alone*.

The detailed result is :—

1st. Mr. Curtis (Victoria), *Micky*, 11 pts.

2nd. Mr. E. Vanner (Kent), *All Alone*, 9 pts.

Mr. G. Lines with his new 15-c.c. hydroplane "Sparky"

Mr. B. Whiting with his steam-driven cruiser "Ann"

The Anodising of Aluminium and its Alloys

by L. Camidge

THE anodic oxidation or anodising of light alloys, although a fairly old process, has in recent years come to the fore and many household furnishings and utensils are now treated by this method.

The average model engineer can use the process in his own workshop on many of the component parts made of light alloys which go to make model boats, aircraft, etc., and require a corrosion resistant and coloured surface.

Briefly, the anodic film is purely an electrolytic process which thickens the oxide film already present on all light alloys. The depth of the film obtained by the process I am about to describe varies between 0.007 mm. and 0.015 mm. in thickness.

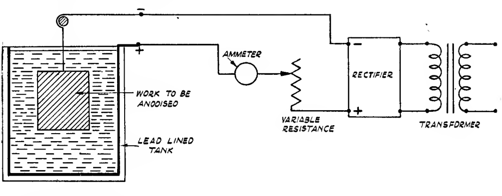
The properties of the anodic film are as follows :

(1) It has a high specific resistance to abrasion and is comparatively tough.
(2) The corrosion resistance is much higher than the parent metal.
(3) Heat is resisted up to melting point of the basis metal.
(4) It is an excellent base for paint.
(5) Resistance is high to the passage of an electric current.
(6) It will absorb dyes readily.

It is the first, second, and last properties which are the most interesting, both commercially and to the model engineer.

There are three main processes in use in the commercial field at the present time; the chromic acid, the sulphuric acid, and the oxalic acid methods. For the requirements of the model engineer the sulphuric acid process is the one likely to be most useful as it gives a comparatively tough film which absorbs dyes readily. The film is transparent and colourless, which also makes it ideal for colour absorbing.

Either a.c. or d.c. current may be used in anodising light alloys, but as the d.c. process is superior from the model engineer's point of view, this is the one I shall describe. The maximum value of the current flowing through the object being treated should be at about 10 amps. per sq. ft. of surface. A transformer and rectifier giving an output of 10/15 volts at 5 amps. I find will cover the majority of small parts.



Equipment Required

A transformer and rectifier giving an output of 10/15 volts at a maximum of 5 to 10 amps, depending upon the area the user wishes to treat. An ammeter to check the current flow, together with a variable resistance of about 30 ohms in value capable of carrying the maximum current which will be used, to control the flow of current into the work.

A lead lined tank or vat which must be acid resisting; an old glass accumulator cell of a suitable size serves the purpose very well. The lead with which the vat is lined should be of the high purity type, large enough to be level with the top of the glass cell. The edges of the box so formed when bent need not be joined together, a small lug is left on one edge for connection to the d.c. supply.

The diagram gives the necessary connections of the complete circuit. As it will be seen the positive side is connected to the vat, the lining of which acts as the anode, the negative side is connected to the work which is to be anodised.

Have the vat large enough to immerse the work completely leaving 1 or 2 in. all round in relation to the lead lining. The sulphuric acid should have a specific gravity of between 1,200 and 1,300 and the temperature of the acid kept down to about 25 deg. C. From time to time the acid will require renewing due to contamination by aluminium sulphate which is formed by the process of anodising and should not exceed 1 per cent.

The Process

The article which is to be anodised is first polished and scratch marks removed as these will be emphasised during treatment. An electrical connection is made to the work by means of an aluminium wire or strip. This connection must be good and preferably in a place which will be out of sight on the finished article. Copper connections will not be suitable as the copper is rapidly attacked by the electrolytic action and may break away from the work; it also absorbs current which should be flowing into the work.

The next step is the degreasing of the article. The importance of this cannot be too highly stressed and any trace of oil or grease and even finger marks will spoil the anodic film and in consequence give patchy dyeing. Once the work has been connected to the wire or strip, all handling must from now on, until the process is complete, be by means of the connecting wire or strip. Holding the article by this means it is thoroughly degreased in some degreasing agent such as trichlorethylene, carbon tetrachloride, or ethylene-de-chloride, by immersing and swilling in this liquid. It is then allowed to dry, after which it is lowered into the vat, care being taken to ensure that it is well covered by the electrolyte. An insulating strip of material resting across the top of the vat and the aluminium wire or strip wrapped around it will hold the work in position.

The vat is now connected up as shown in the diagram and after seeing that all the resistance is in circuit, switch on the current, and adjust the variable resistance until the correct current is flowing. The length of time of immersion should be from 25 to 30 minutes.

The correct amount of current to pass through any article or articles in the vat is at the rate of 10 amps. per sq. ft. of surface. If a tube or any kind of hollow article is being anodised the area taken is both the inside and outside surfaces, the hollow surface should be towards the top of the vat to allow gases to have free escape.

After the period of 25 to 30 minutes has elapsed the current should be switched off, the article removed from the vat by means of the aluminium connecting wire or strip, being careful not to touch the anodised surface, and washed under clean cold running water until all traces of acid is removed.

If no other process such as dyeing is required and just a plain anodised surface wanted then the anodised article should be steamed over boiling water for 15 minutes, which will seal the film and the article can now be handled.

If it is required to dye the film then it must not be steamed or handled but immersed in the dye bath which should have been previously prepared.

Dyeing the Film

Some of the beautiful pastel shades or rich dark colours often seen on light alloy fruit bowls and various other articles can easily be obtained by the model engineer in his own workshop by using the previous anodising process and suitable dye solutions.

The same article can be given a multi-colour effect by dyeing a light shade then stopping off where the basic colour is to be retained, then dyeing the next darker shade or colour. Nitro-cellulose lacquer is suitable for stopping off as this can be dissolved away by acetone when no longer required. Ordinary household dye is quite suitable for most purposes, and I find that two tubes of the dye to 2 pints of water with a tea-spoonful of vinegar included gives a satisfactory solution.

For light colours the dye is used cold, the article being swilled about in it until the required shade is obtained, after which it is steamed off over boiling water for 15 minutes to seal the film. A coating of wax polish helps in sealing the film after the steaming and also gives a smooth finish.

Darker colours and black are dyed in a solution just below boiling point after which the treatment is the same as for cold dyeing.

The dye solution if made fairly thick may be applied by means of a brush and many fine multi-colour effects can be obtained by this method.

An old enamelled pan makes a good dye container and is preferable to iron or tin which may set up chemical action and spoil the dye solution.

A well ventilated room is advised when using the anodising process, as the acid fumes given off will irritate the throat.

A Society Acquires a Road Locomotive

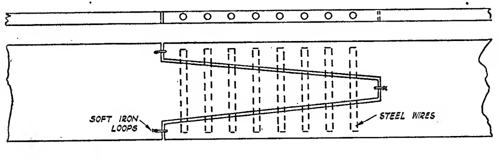
We were pleased to learn from Mr. W. J. Hughes, who visited us recently, that the Sheffield and District Society of Model Engineers has acquired a Burrell showman's road locomotive. This engine was last licensed in 1946, and after some minor repairs it should be in running order again. It was purchased by Mr. E. S. Brook and presented to the society by him, a very generous gesture which is much appreciated by the members. For the time being, the engine is stored at the site of the society's permanent track at Mosborough Moor, near Sheffield. We hope to be able to publish a photograph of this most important acquisition in due course; in the meantime, we commend to other societies the idea of saving traction engines in this way. The problem of finding the space in which to store them is, of course, a major one; next to that comes the question of meeting the financial outlay. The total cost, however, is not always prohibitive, and the ways and means of meeting it are usually well worth considering.

Fasteners for Flat Belts

by W. V. Pagett

I WAS interested in a recent article on the above subject, which prompts me to describe an arrangement that has proved extremely satisfactory over a period of several months. The sketch may be to an extent self-explanatory, but a brief description will also be found helpful.

be a tight fit in the holes, and about $\frac{1}{8}$ in. less in length than the width of belt. This will have the effect of sealing them in place, and the three narrow ends are kept in position by soft iron wire loops passed from the underside and twisted on top, cut off short and hammered flat. The belt



My belt is 1 in. wide by $\frac{1}{8}$ in. thick, and was cut at the ends as indicated, and rather longer than twice the width; these ends are now placed together, clamped edge upwards in a machine vice, and a number of small holes drilled at about $\frac{1}{4}$ in. centres. Into these holes are inserted steel wires about 14 gauge 0.080, which should

transmits $\frac{1}{4}$ h.p., and is running between countershaft and lathe mandrel at 10 in. centres, the smallest cone pulley being $2\frac{1}{4}$ in. diameter. It is absolutely silent, smooth, flexible, and without jump or slip. Although no originality is claimed for this idea, it can be thoroughly recommended.

For the Bookshelf

First Steps in Engineering for the Apprentice, by Major G. McAlpine. (London: Percival Marshall & Co. Ltd.) Price 3s. net.

This is a most excellent little manual of advice to budding engineers. It stresses, first, the serious shortage of skilled men in the engineering industry and, secondly, the attractions of the various branches of the profession which need the application of real craftsmanship, in spite of the mechanised mass-production methods now so commonly found.

The text is stimulating, and the advice given is thoroughly sound; in fact, the little book is a potent guide to all young people, in whom it should do much to excite an interest in and an appreciation of craftsmanship and all that it entails. There is a beginning to everything, and an engineering career is no exception to this fact; and to know how to avoid taking the wrong steps at the start is to ensure the correct development towards a good job in the future. This is more essential now than at any other time in the history of engineering, and Major McAlpine's little book, therefore, provides opportune help and counsel on the subject.

The Hundred of Manhood and Selsey Tramway, by E. C. Griffith, B.A. (Farnham, Surrey: 23, Downing Street.) 42 pages, size $5\frac{1}{2}$ in. by $8\frac{1}{2}$ in. Price 4s. 6d.

This is another extremely fascinating story of a gallant little railway which began its existence with an apparently promising future, prospered for a time and then fell upon evil days, to close down after 38 years, the last ten of which were a period of struggle against heavy and increasing misfortune. Mr. Griffith has collected a great deal of historical information and many photographs which he has put together into a valuable record that should not be missed by anyone interested in railway history.

PRACTICAL LETTERS

Water-tube Boilers in Casing

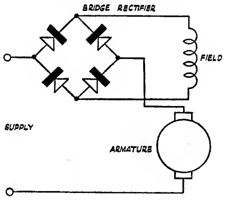
DEAR SIR,—Having experienced loud reports in my traction engine boiler firebox which generally blow the meth. flames out, I put the trouble down to water from the exhaust passing down the casing, which it does, and causing the flames to splutter, thus causing the said explosions. But when "L.B.S.C." on onc occasion mentioned the matter and said it occurred inside the tubes, I thought—well, nothing can be done about it; but to me it seemed that the water running down the casing was the cause, and I have seen the flames spluttering through it and loud reports taking place quite frequently. So I decided to drill a small hole in the bottom of the smokebox for the water to get away—well I have heard no bangs since—So what!

Yours faithfully,
Cardiff. T. THOMAS.

Reversing d.c. Motors

DEAR SIR,—I was interested in Mr. Druett's method of reversing d.c. motors, and it occurred to me that for small motors a much simpler method could be used which does not require a relay.

If the motor field is fed from a selenium bridge rectifier then reversal of the supply changes the direction of current in the armature, but not in the field and so produces the desired effect.



The diagram shows thc connections for a series motor, notice that the rectifier whilst having to pass the full load motor current has only to withstand a back voltage equal to the volt drop across the field. Which latter may be quite small compared with the motor supply voltage.

A 6 V .5 A selenium bridge rectifier is quite small, has a vcry small voltage drop and would be suitable for many of the 28 V series motors taking up to .5 A that are available on the surplus market.

A similar arrangement could obviously be used for a shunt motor, the rectifier being selected to withstand the full supply voltage, but it would only have to pass the field current.

I think that this method which does not require a relay would have definite advantages for many applications where space is at a premium, and relays are often inclined to be troublesome.

Yours faithfully,
Eltham. C. J. WAYMAN.

"Lord Fisher"

DEAR SIR,—*Re* the photograph in the May 19th issue of THE MODEL ENGINEER of Miss Beach's Burrell engine, I feel it is time I wrote to clear up some of the misunderstanding regarding this machine.

It was not decorated or overhauled during last winter. At the time it was reported to be at Winchester, it was, in fact, standing at Miss Beach's winter quarters at Southall. From where I am living I could sec it anytime I cared to look out of the window!

The only decorating was to the canopy, and that was because this engine only came into Miss Beach's possession at the end of last summer. Her former engine, "Lord Fisher" (No. 3694), was withdrawn from service, and as stated by Mr. Durrant (February 17th, 1949) was later broken up, together with another Burrell, "Conqueror," a very old machine that had been out of use since 1939. Now, as there were a few weeks more to go before the end of the season, when "Lord Fisher" was laid off, another engine had to be obtained quickly, and the first one to be used was a very poorly maintained Burrcll, number unknown, named "Sunny South." This, however, was only used for a very short while, and then the engine you saw at Richmond came along. Incidentally, this engine's nameplates are the ones removed from No. 3694, and so, too, is the generator. Now, it may be that "Sunny South" was sent to Winchester, but I "hae ma doots"! Anyway, it hasn't reappeared.

The small Burrell which you saw at Richmond (No. 3497), carries the nameplate from the old "Conqueror" mentioned above, and is, in fact, the "May Queen" mentioned by Mr. W. Boddy (May 6th, 1948). Its weight is $7\frac{1}{2}$ tons, not $6\frac{1}{2}$ as he statcd.

By the way, when you saw it at Richmond, did you notice that it now has pneumatic-tyred disc wheels fitted at the front? This was done quite recently.

Both these engines were at Hillingdon on a week-end in May, and the small one was excellently placed for photographing.

I hope this information will be of some interest, and perhaps help to clear up what appears to be some misunderstanding.

There are two old engines lying at Hayes End (Middx.), belonging to Miss Beach's brother, Mr. W. Bcach, and until a short while ago, there were four old Fowlers lying at Billy Smart's place, also at Hayes End, but I think these havc been removcd.

It was surprising that you found No. 2984 so dirty, because whcn it left here just previously, it had been well cleaned and polished.

Yours faithfully,
Southall. "C.W.L."